

Complications of Myocardial Infarction

Sunil Mankad, MD, FACC, FCCP, FASE
Associate Professor of Medicine
Mayo Clinic College of Medicine
Director, Transesophageal Echocardiography
Associate Director, Cardiology Fellowship
Mayo Clinic, Rochester, MN
mankad.sunil@mayo.edu
[@MDMankad](#)

DISCLOSURE

Relevant Financial Relationship(s)

None

Off Label Usage

None

Echocardiography in Acute MI

- Ideal imaging modality to detect complications
 - Non-invasive
 - Portable
 - Low-risk
 - Serial comparison studies
 - Information quickly available

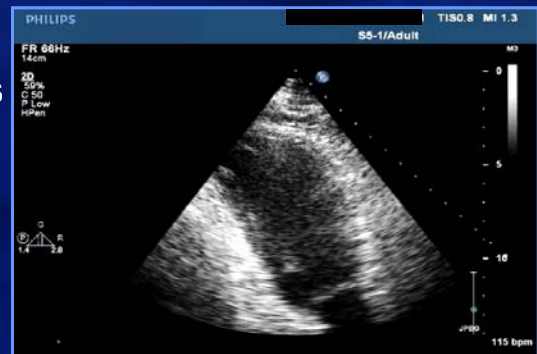


Case

- 62 year old male
- Anterior Wall STEMI; Primary PCI (6 hrs after chest pain onset)
- Troponin T = 3.2 ng/ml

Question

- What is the incidence LV thrombus despite dual anti-platelet therapy over next 3 months ?
 - A. $\leq 1\%$
 - B. 2-5%
 - C. 6-10%
 - D. $>10\%$



LV EF 36% (48 hrs post-PCI)



Frequency of Left Ventricular Thrombus in Patients With Anterior Wall Acute Myocardial Infarction Treated With Percutaneous Coronary Intervention and Dual Antiplatelet Therapy

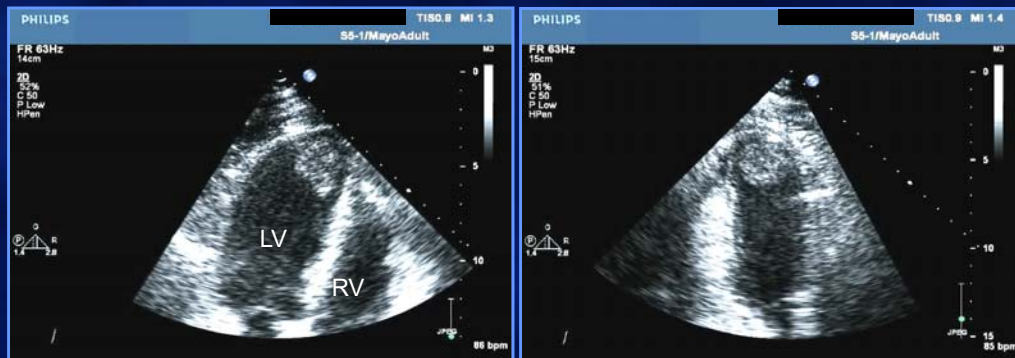
Svein Solheim, MD, PhD^{a,b,*}, Ingebjørg Seljeflot, PhD^{a,b,c}, Ketil Lunde, MD, PhD^d,
Reidar Bjørnerheim, MD, PhD^b, Svend Aakhus, MD, PhD^d, Kolbjørn Forfang, MD, PhD^d, and
Harald Arnesen, MD, PhD^{a,b,c}

Am J Cardiol 2010;106:1197–1200

Conclusion: LV thrombus formation is a frequent finding in patients with anterior wall ST elevation myocardial infarction treated acutely with PCI and dual antiplatelet therapy and should be assessed by echocardiography within the first week.



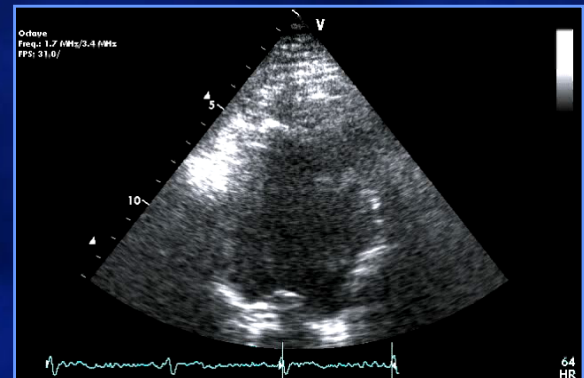
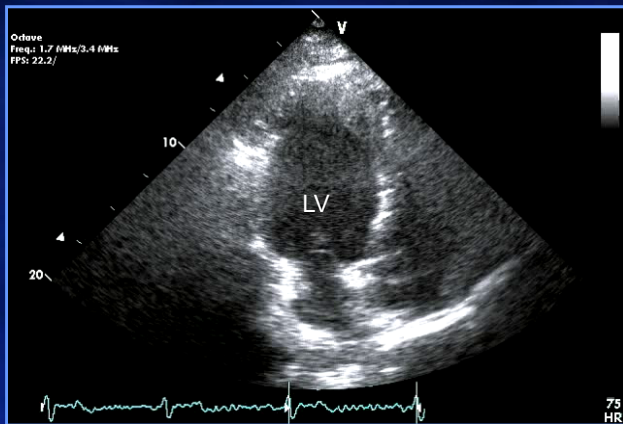
LV Thrombus Post-MI



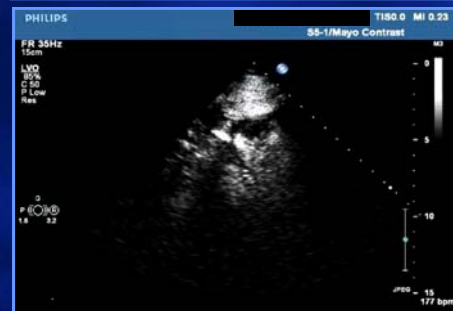
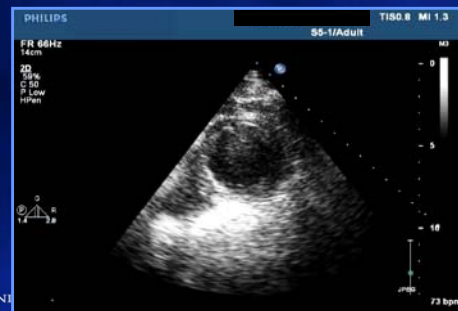
- Static flow in region of akinesis or dyskinesis (apical location most commonly)
- Reduced EF (<30%)
- Risk of Emboli
- Differentiate from trabeculation (multiple planes)



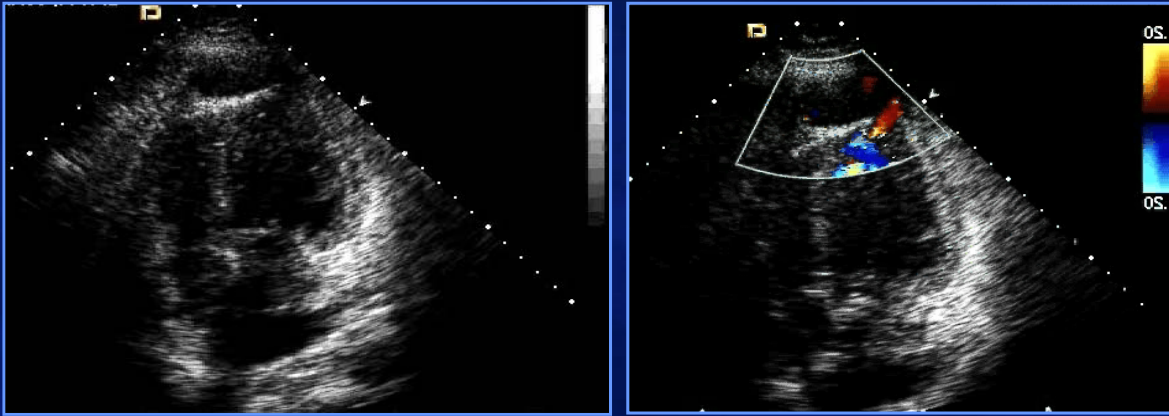
Mobile LV Thrombus



Contrast Echocardiography

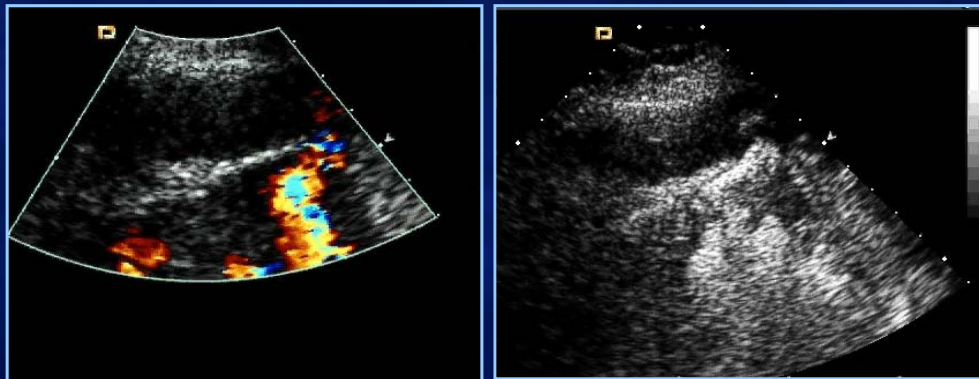


LV Pseudoaneurysm



Color Doppler may be very helpful

LV Pseudoaneurysm



- Contrast echo can also be helpful in making the diagnosis and determining the size of the neck which is important in differentiating a pseudoaneurysm (narrow neck) from a pseudo aneurysm (wide neck).

LV Aneurysm vs Pseudoaneurysm



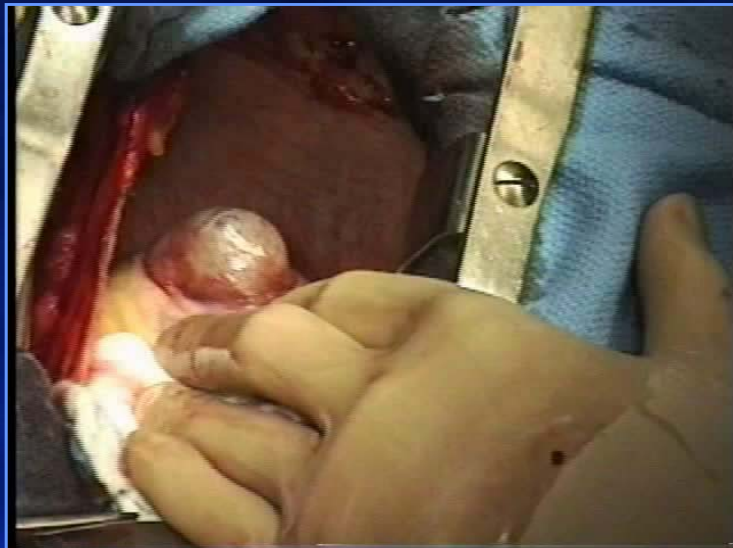
- All 3 layers of myocardium (epicardium, mid-myocardium, and endocardium) are present
- Fibrotic Scar



- Only the pericardium is keeping blood in the ventricle

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Left Ventricular Pseudoaneurysm



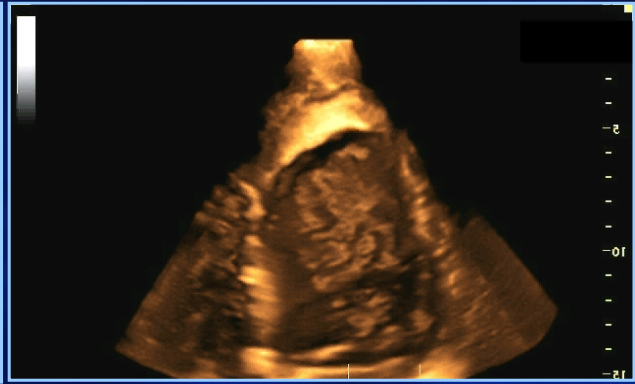
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Video by Dr. Roger Click

LV Thrombus and Aneurysm

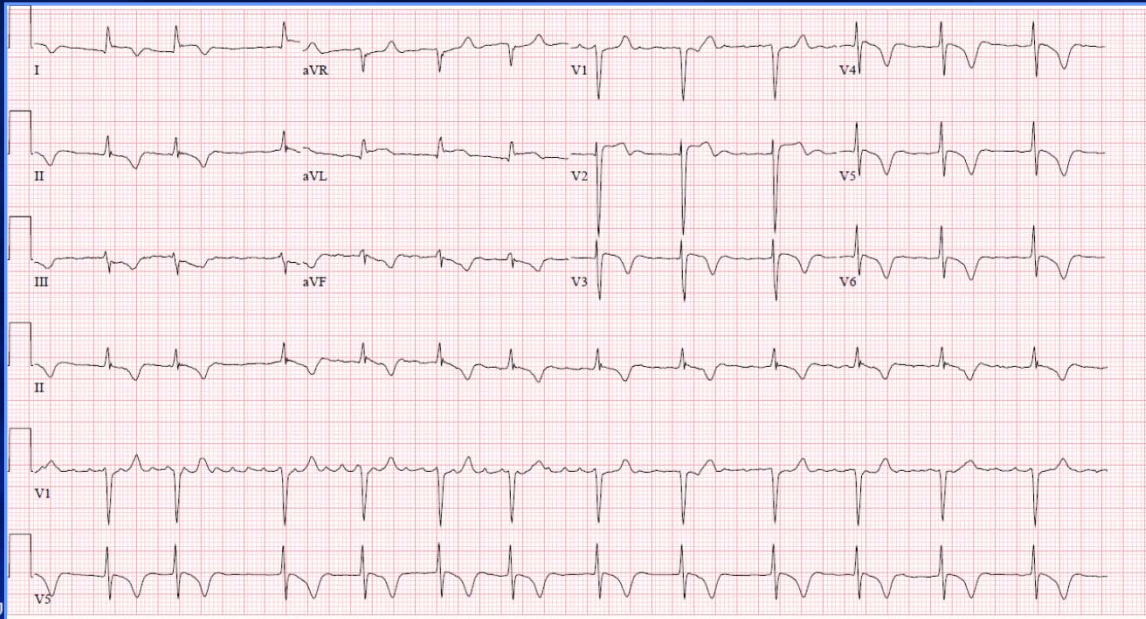


2D Four Chamber View

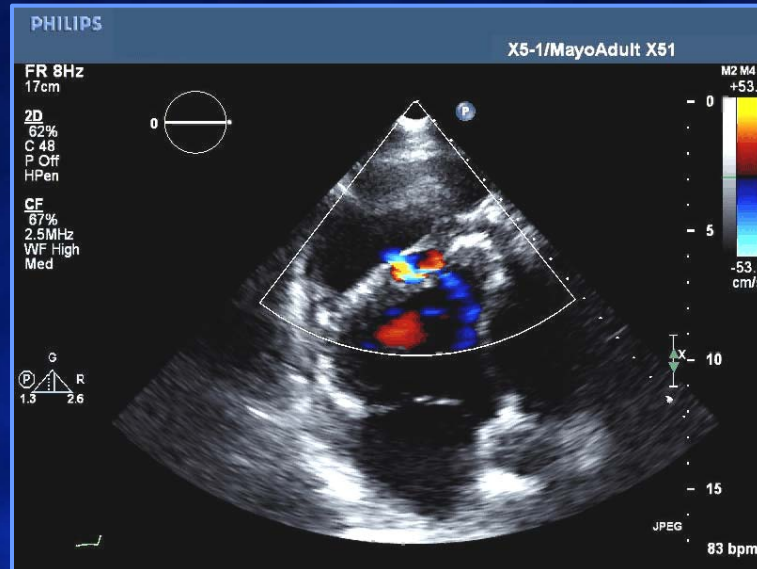


3D Four Chamber View

86 year old male with STEMI



LV Pseudoaneurysm: “Too and Fro Flow”



Ruptured LV Pseudoaneurysm



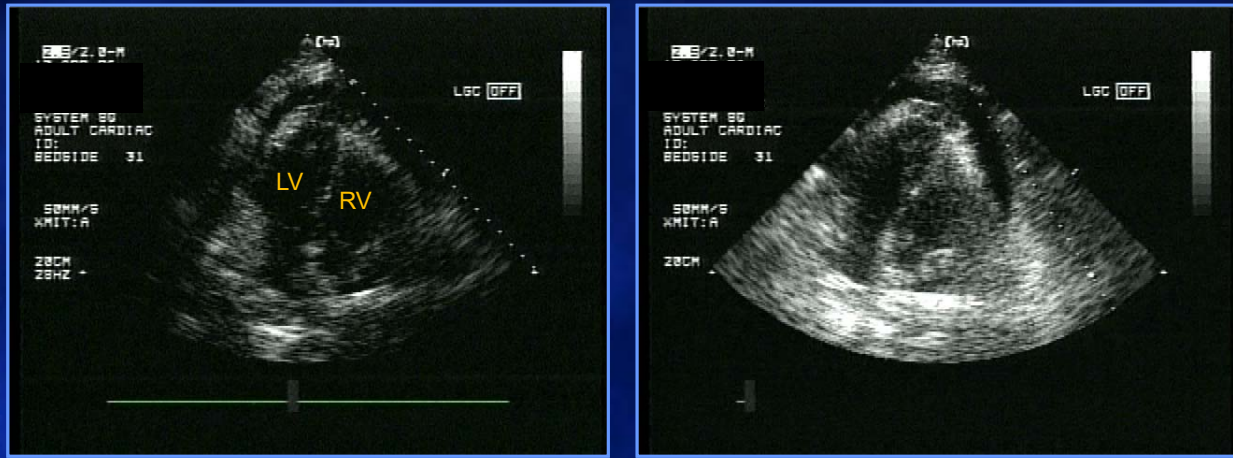
LV Aneurysm vs LV Pseudoaneurysm

- Post-MI LV **pseudoaneurysm** occurs when a rupture of the LV free wall is contained by overlying, adherent pericardium → **usual treatment is urgent surgical repair**
- Post-MI LV **aneurysm** is caused by scar formation resulting in thinning and expansion of the myocardium → **usual treatment is conservative** unless refractory angina, heart failure or ventricular arrhythmia

Case

- 78 year old female
- Presented with chest pain and evidence of “NSTEMI” by biomarkers
- EKG - nonspecific
- Echocardiogram: Preserved EF, lateral HK
- Cath: occluded diagonal, 70% RCA and LCx → planned medical tx
- Worsening dyspnea and atypical chest pain 48 hours after admission

Stat Echo



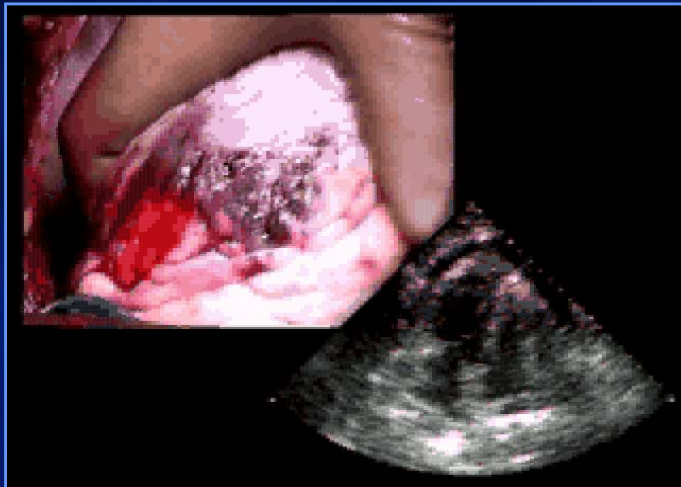
Taken Emergently to OR

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Myocardial Free Wall Rupture

30-40% of patients may have “subacute” free wall rupture

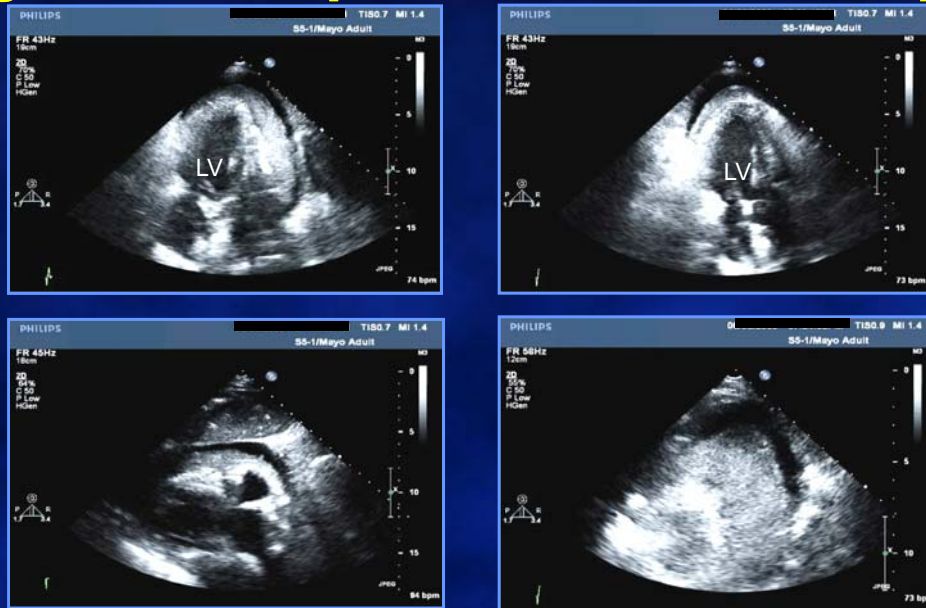
- Hypotension
- Nausea/emesis
- Pericardial chest pain



Images by Dr. Rick Nishimura and Dr. Roger Click

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Coagulum Tamponade from LV Rupture



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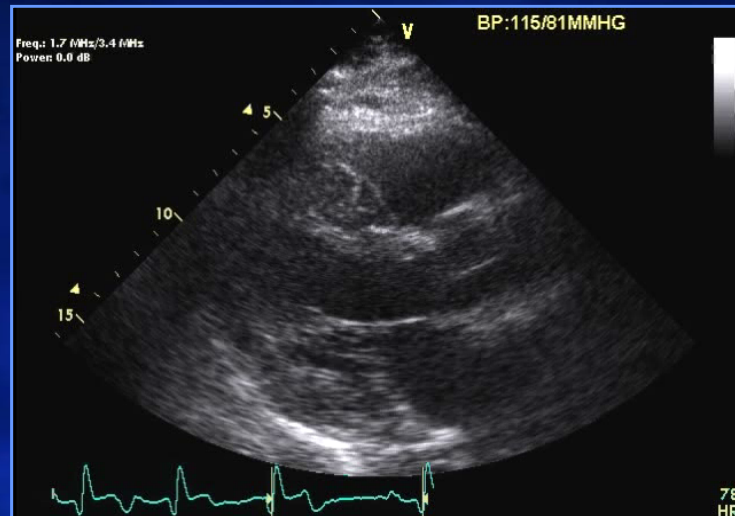
Myocardial Free Wall Rupture

- Occurs in approximately 1% of MI's
 - Accounts for up to 8-17% of deaths
- More common in women, hypertensive and older patients
- Single CAD
- Usually no clinical warning signs
 - Sudden death

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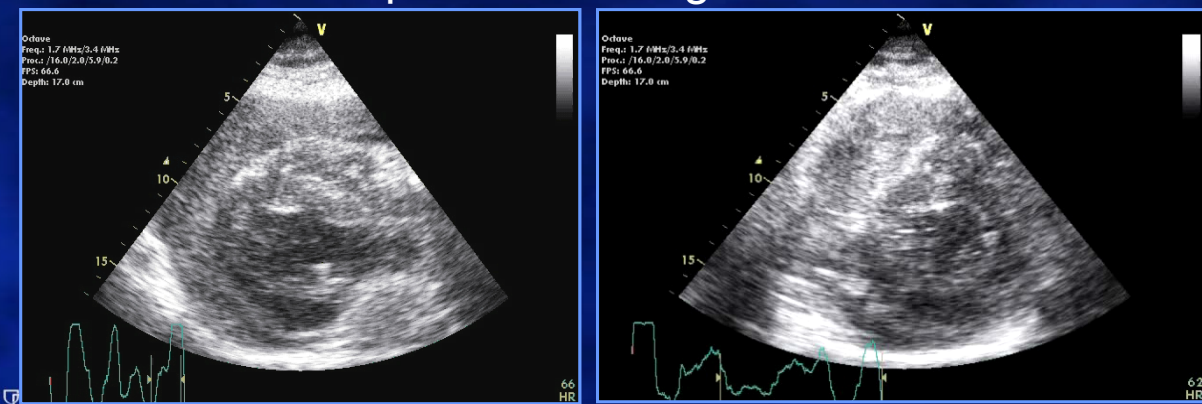
More Typical Scenario: Myocardial Rupture

- 65 year old male
- Inf Lat MI, PCI with DES, EF 45%



Two days later

- Patient in bathroom → syncope
- Stat Echo during code
- Echo reveals rupture with coagulum



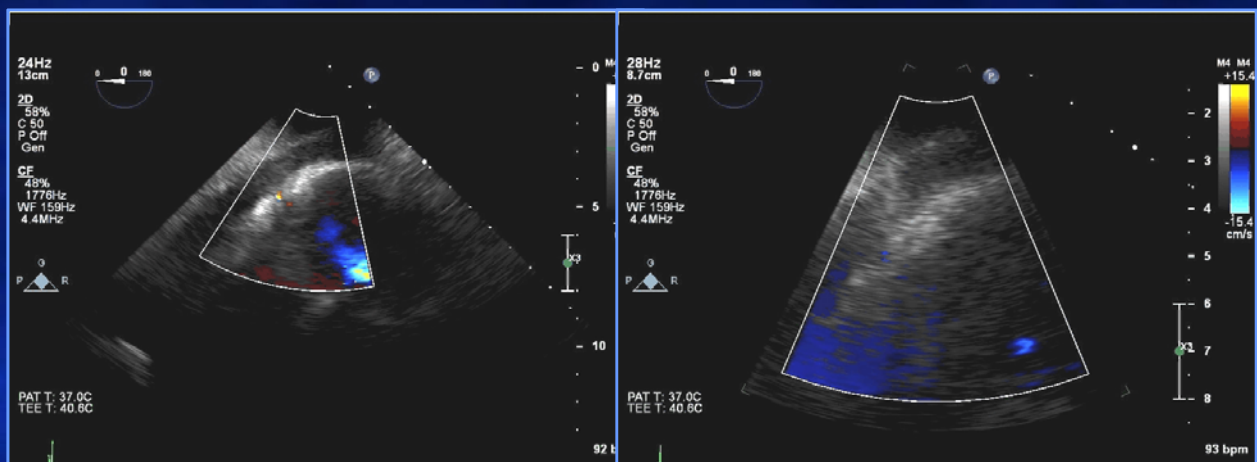
Myocardial Rupture → Tamponade → Death



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Image Courtesy of William Edwards, MD

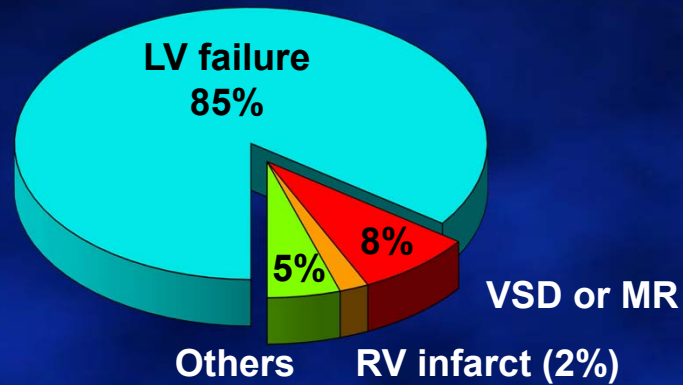
TEE: Helpful to Identify Myocardial Rupture



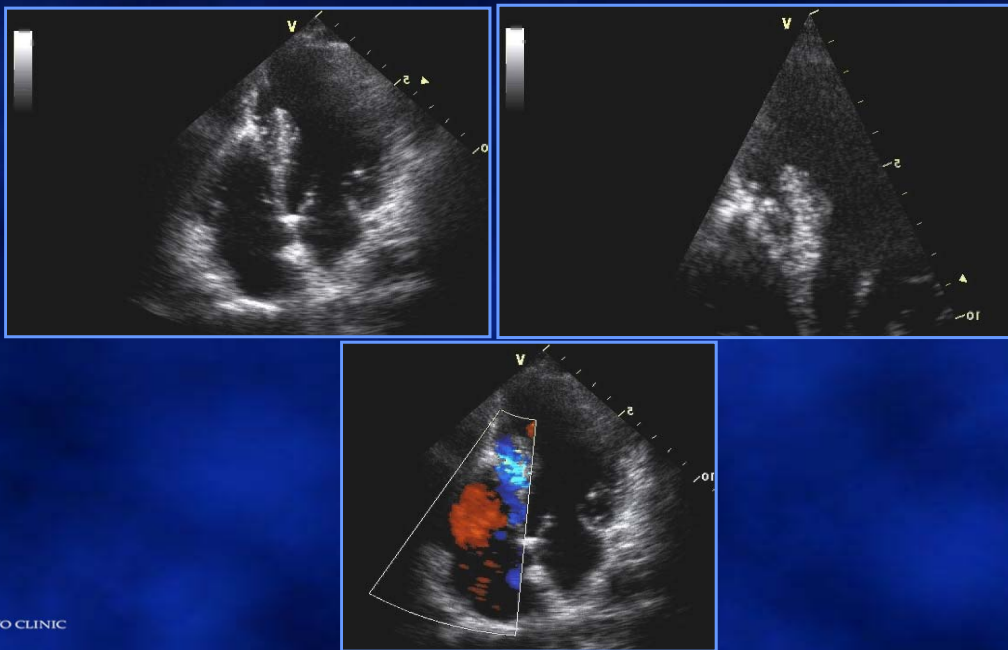
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Etiology of Cardiogenic Shock After Acute MI

251 patients from 19 centers



Post-MI Ventricular Septal Rupture or Defect



Post MI VSD: GUSTO-I Study

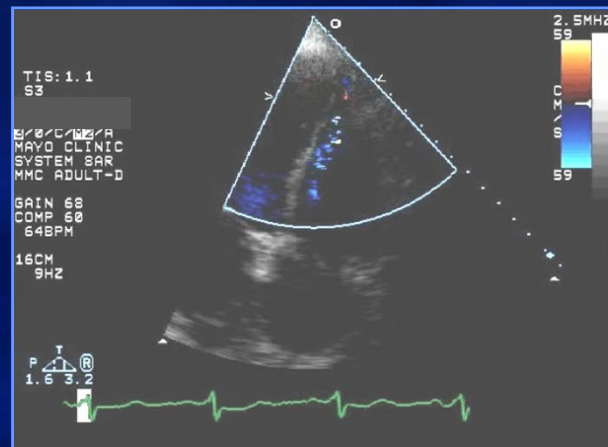
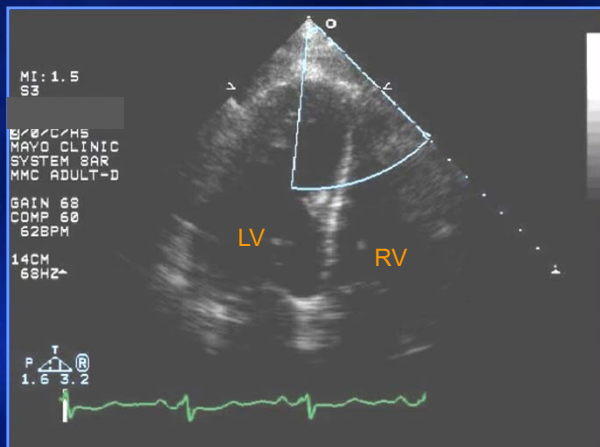
- Incidence 0.2% (84 of 41, 021 patients)
- Onset 1 day → Surgery
- Mortality 74% (**47%** vs **94%**) → Medical Tx
- Association with
 - Age
 - Anterior MI
 - Female sex
 - No previous smoking

Crenshaw BS et al: *Circulation* 2000; 101:27

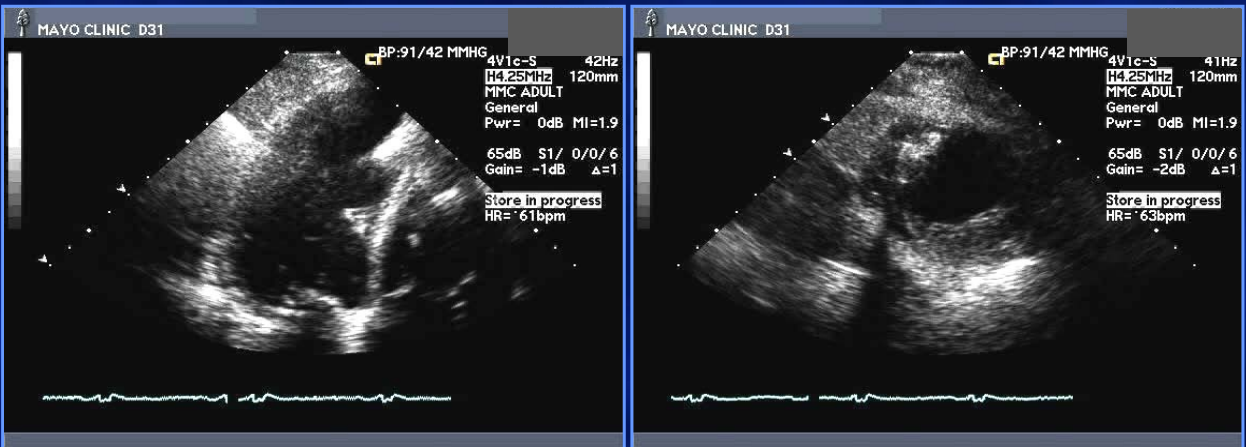


Case: Apical VSD

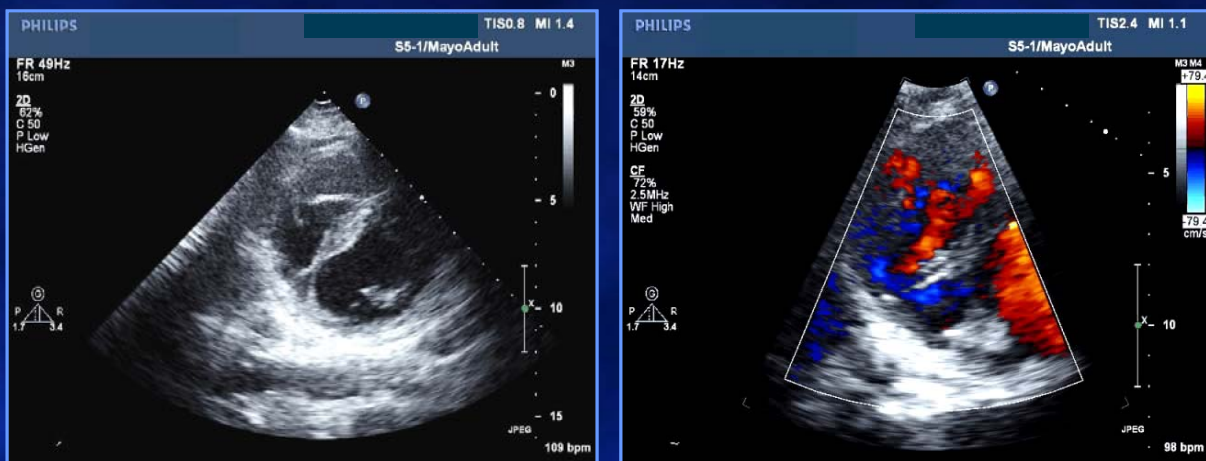
- 84 year old female, post-MI day 5
- Sudden onset, pulmonary edema, loud murmur



- CHF improved with medical treatment
- Multidisciplinary discussion, not felt to be a good surgical candidate, VSD closed in cath lab with device



Post Infarct Ventricular Septal Rupture



- Poor Location and size for device closure in Cath Lab

RV Dysfunction: Ominous Sign in VSD



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66 yo man – Single Motor Vehicle Accident

Multiple injuries : - Loss of consciousness , confusion

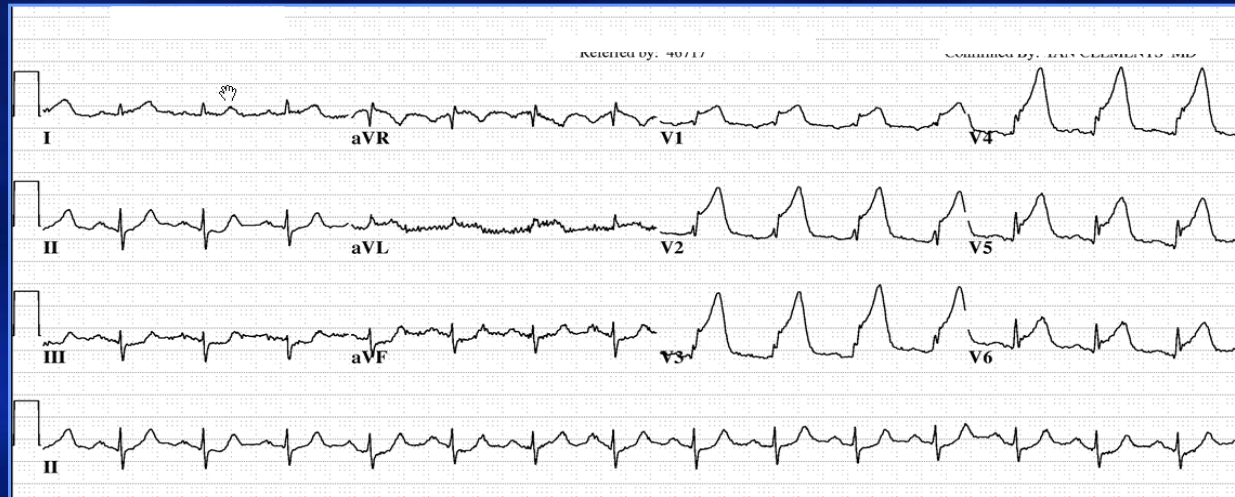
- Open, compound fracture of right leg (mid tibia, lateral malleolus)
- Closed fracture of left leg
- L3 and L5 burst fractures
- Initial BP 130/80 mmHg, pulse 102 bpm
- Lactate level 6.8

In Trauma bay after pan CT : c/o severe chest pain

- SBP decreased to 80 mm Hg

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66 year old man with chest pain : EKG



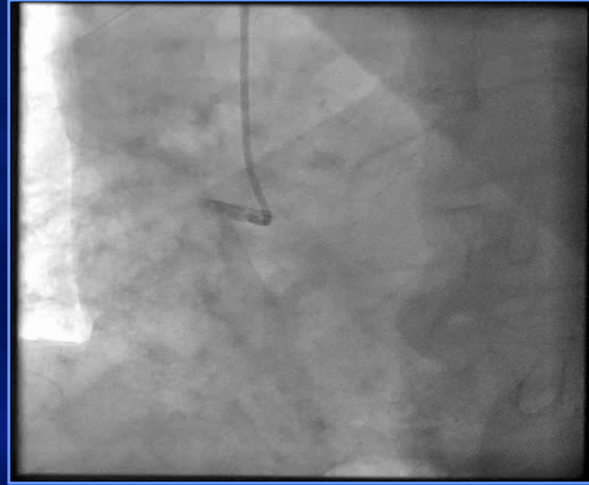
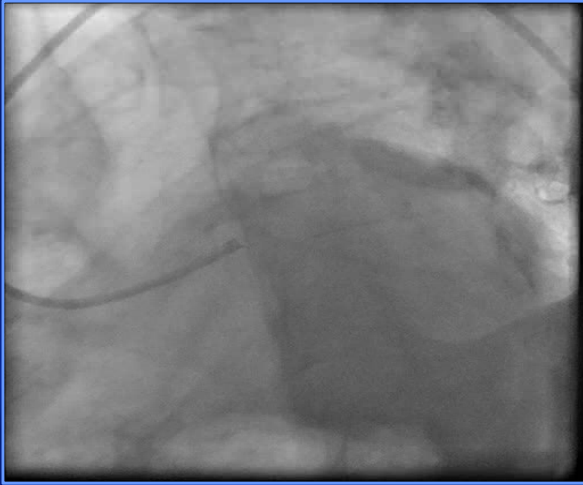
66 yo man – Single Motor Vehicle Accident

- Anterior ST elevation MI
- Cath lab activated

Agreement between cardiology, ortho, trauma, and neurosurgery that MI care superseded injury management

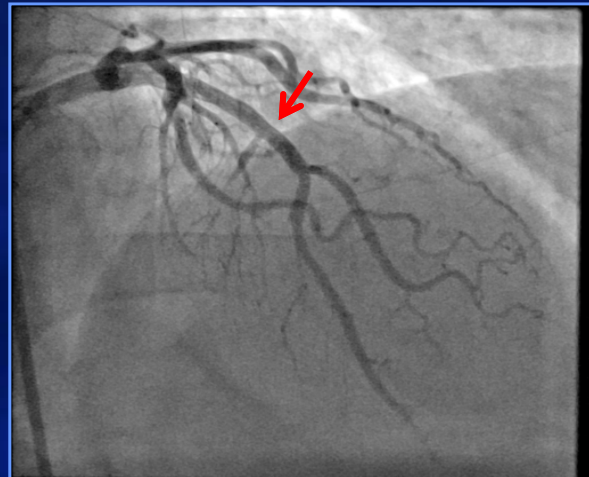
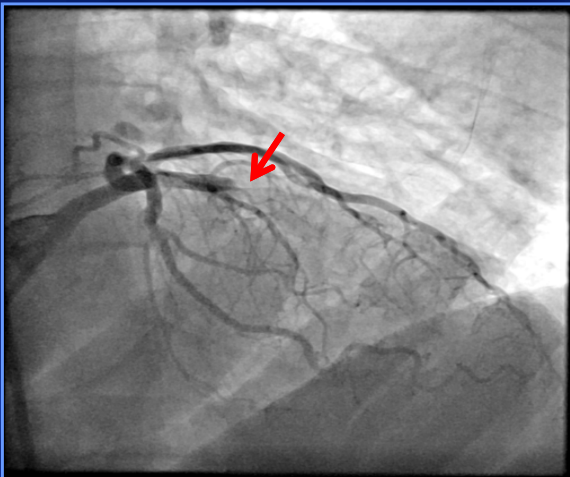
- Rx in ED: aspirin, ticagrelor, heparin
- Emergency coronary angiography

Coronary Angiography



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Successful Revascularization



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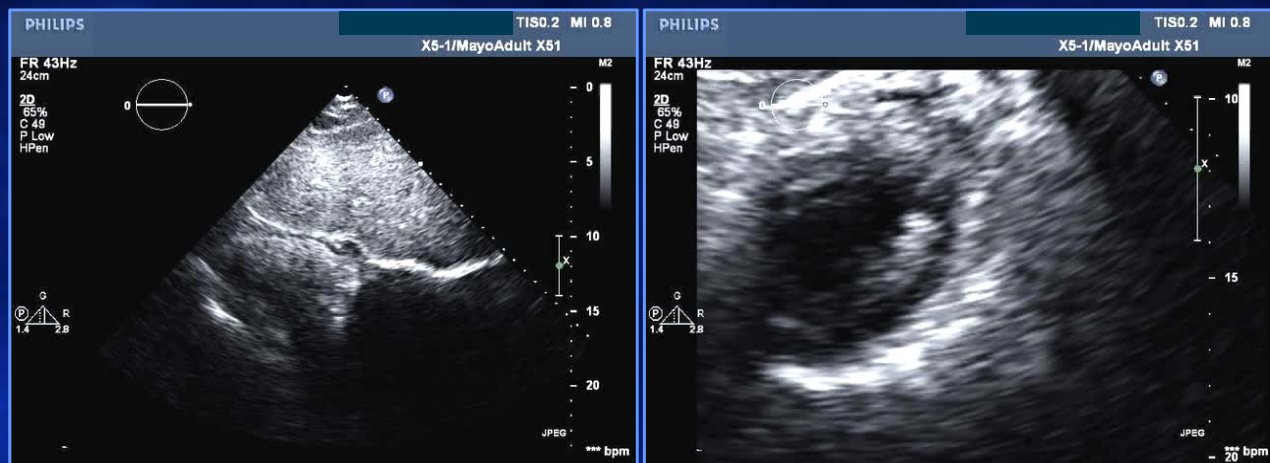
66 year old man – Anterior STEMI

In cath lab, then CCU

- Shock, SBP as low as 50 mm Hg
- Intubated, sedated
- Intra-aortic balloon pump
- IV dopamine, norepinephrine
- IV blood and fluids
- Persistent hypotension (SBP 70-90 mmHg)
- Quick-look Transthoracic Echo



Technically Difficult TTE – Subcostal View



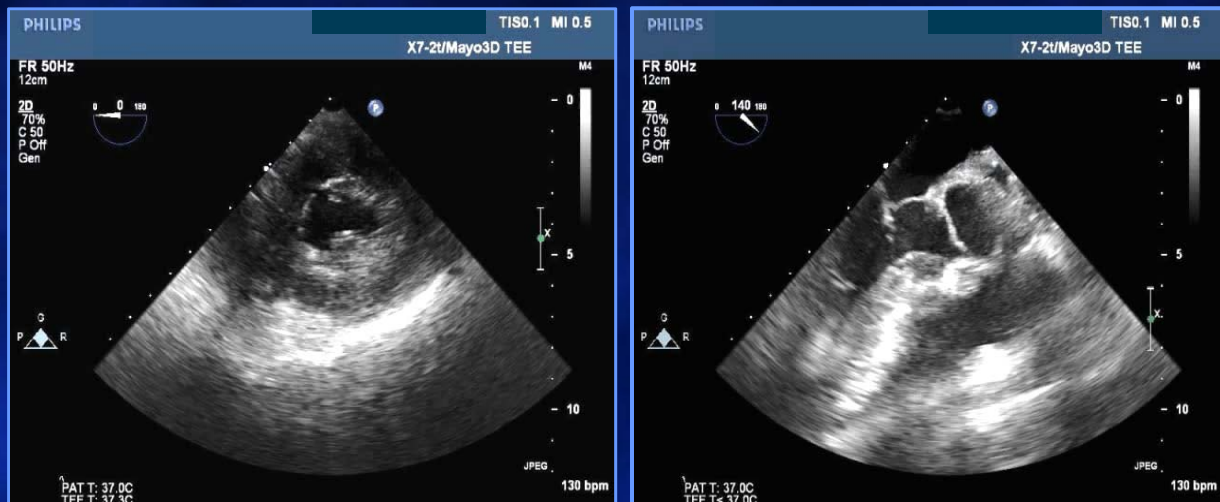
– small IVC, tiny pericardial effusion



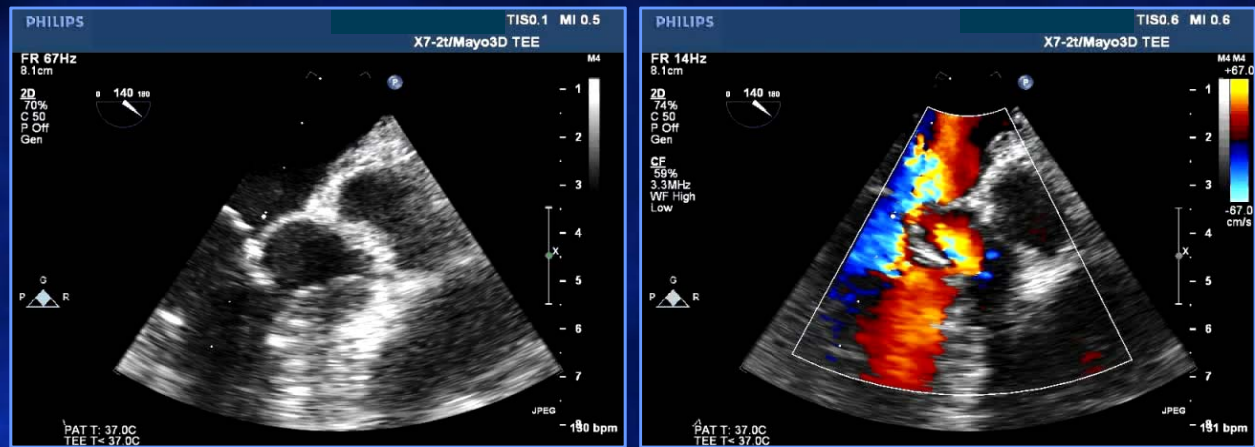
What would you do next?

1. Repeat ECG
2. Repeat CT chest, abdomen
3. Cardiac MRI
4. TEE
5. Supportive medical care in CCU

TEE

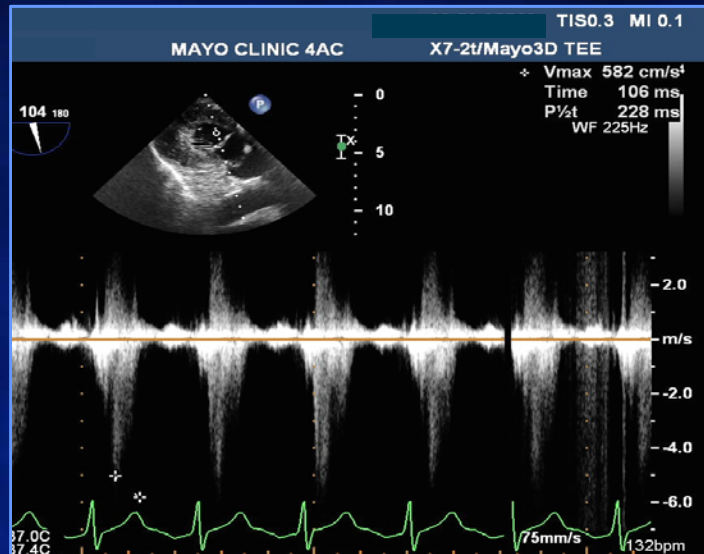


TEE - LVOT



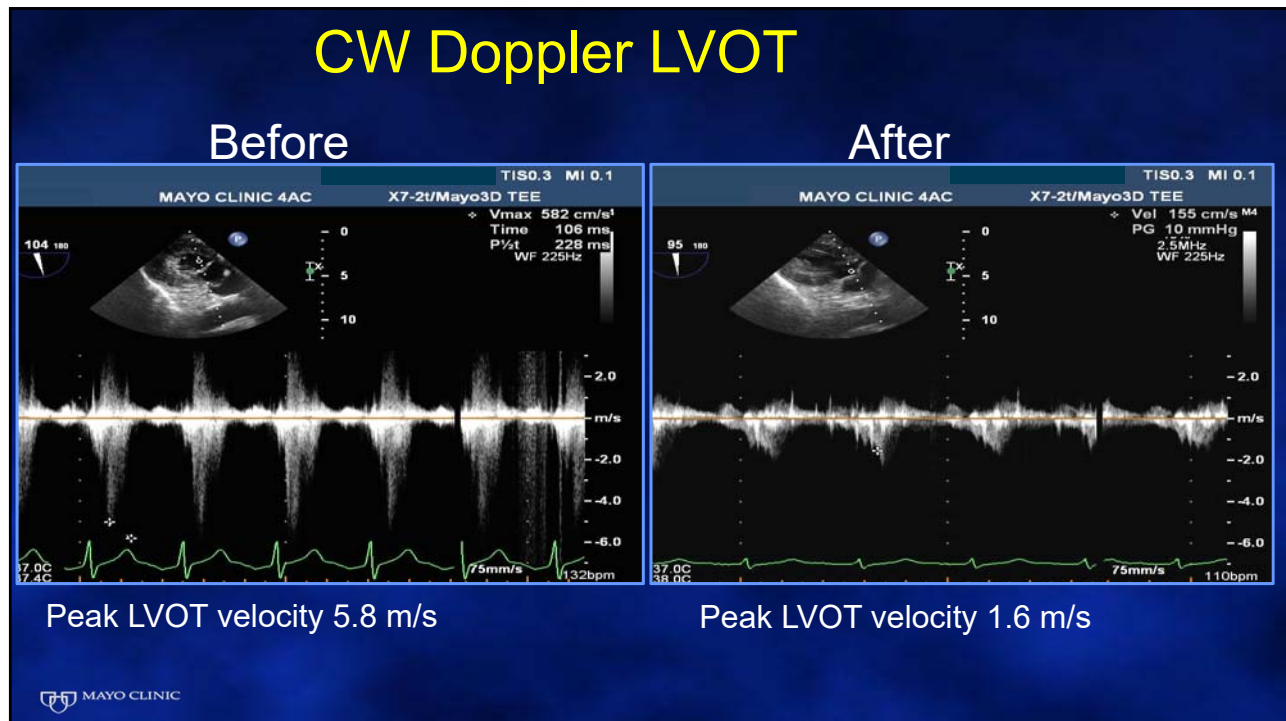
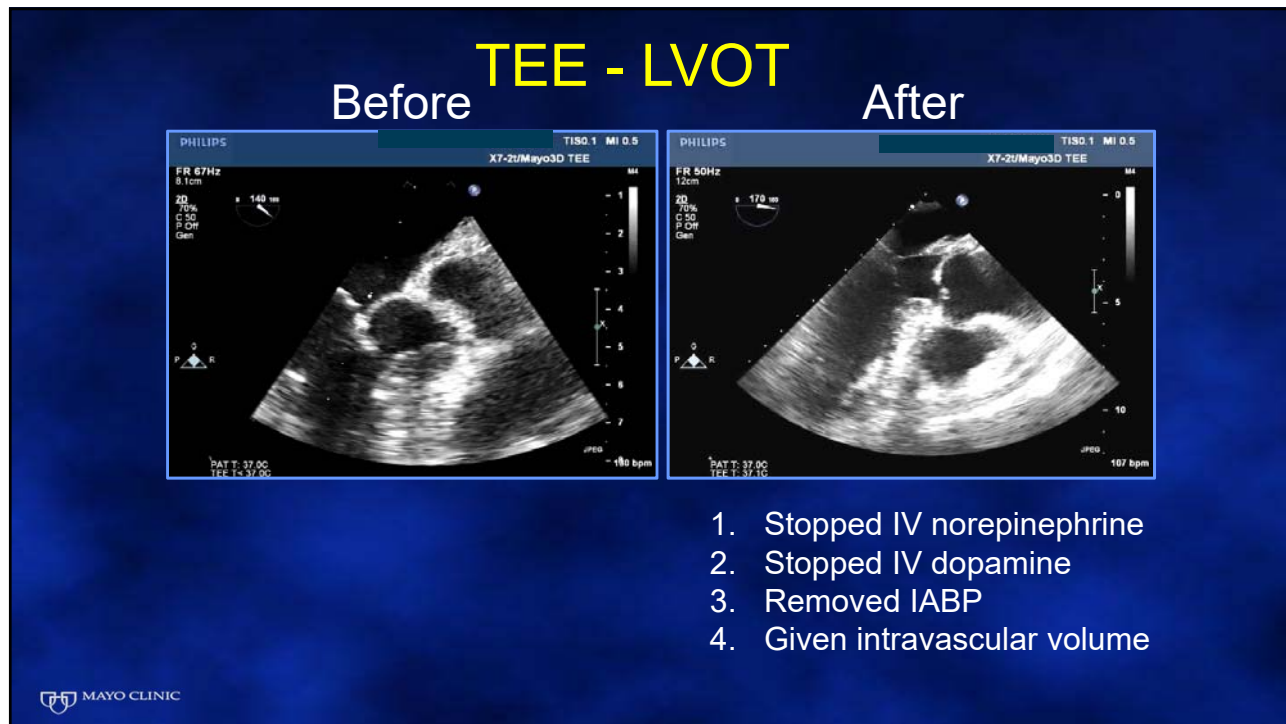
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CW Doppler LVOT



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Peak velocity 5.8 m/s, Peak gradient 135 mm Hg



TEE – LV Function (after)



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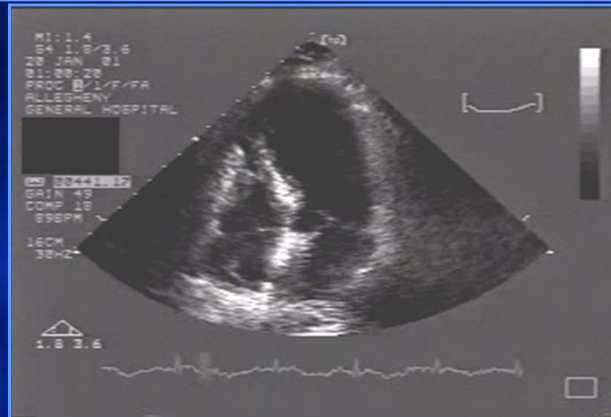
Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION

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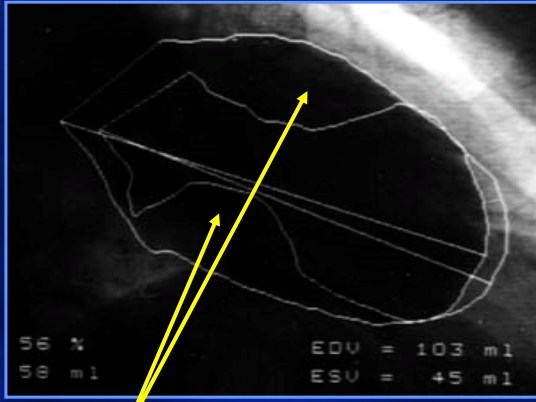
Dynamic Left Ventricular Outflow Tract Obstruction in Acute Myocardial Infarction With Shock: Cause, Effect, and Coincidence

Anand Chockalingam, Lokesh Tejawani, Kul Aggarwal and Kevin C. Dellsperger
Circulation 2007;116:e110-e113



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Apical MI Induced Dynamic LVOT or Mid-cavitary Obstruction

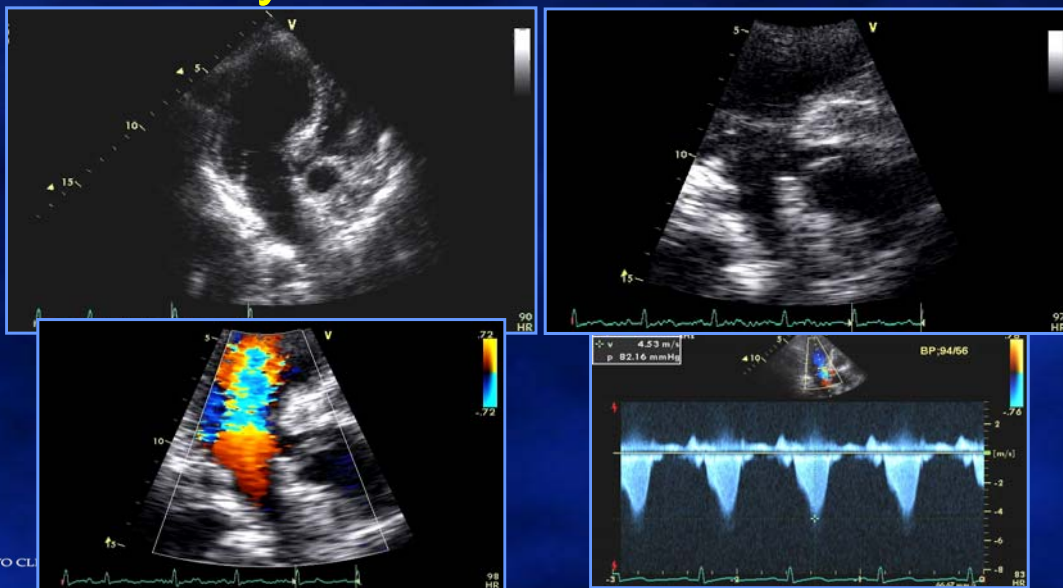


Hyperkinetic Basal Segments

- Joffe II et al. Acquired dynamic left ventricular outflow tract obstruction complicating acute anterior myocardial infarction: serial echocardiographic and clinical evaluation. J Am Soc Echocardiogr. 1997 Sep;10(7):717-21.
- Hrovatin E et al. Dynamic left ventricular outflow tract obstruction in the setting of acute anterior myocardial infarction: a serious and potentially fatal complication? Echocardiography. 2002 Aug;19(6).
- Armstrong WS et al. Dynamic left ventricular outflow tract obstruction as a complication of acute myocardial infarction. Am Heart J. 1996 Apr;131(4):827-30.

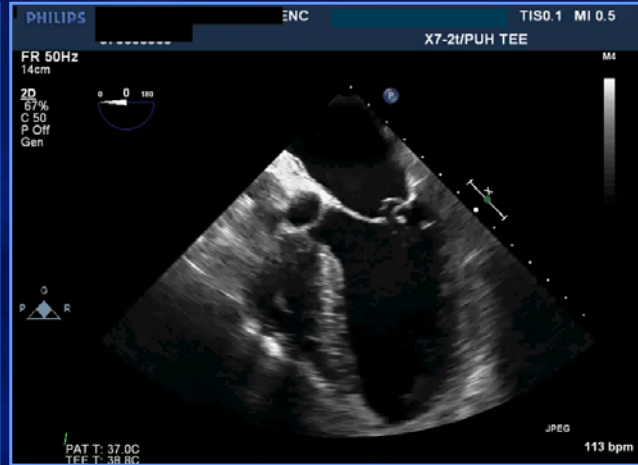
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Patient with Stress Induced CM and Dynamic LVOT Obstruction



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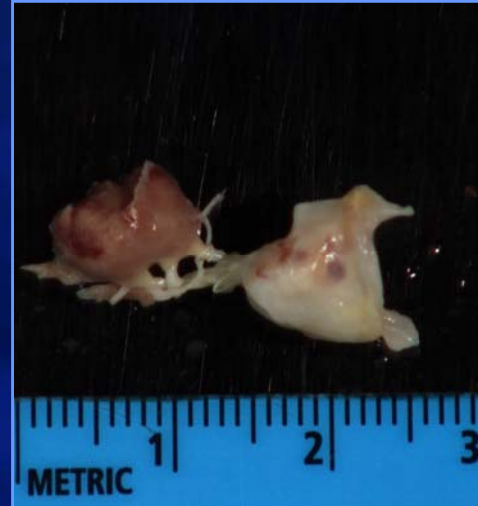
62 year old woman with chest pain and severe pulmonary edema



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Courtesy John Gorcsan, MD

Papillary Muscle Rupture: 3D TEE and Gross Pathology



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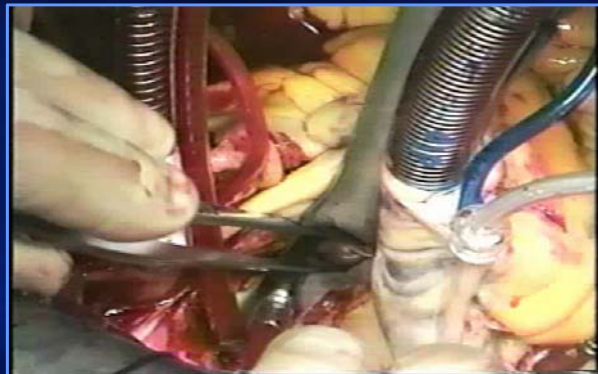
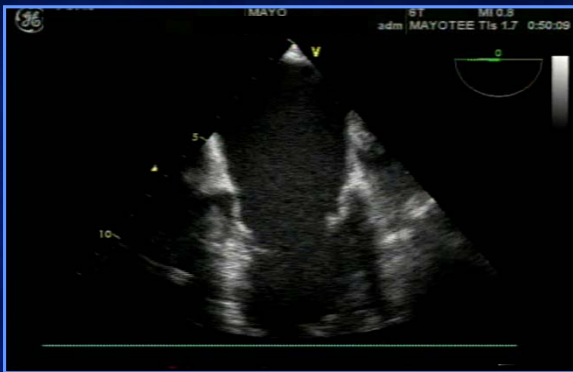
Courtesy John Gorcsan, MD

Papillary Muscle Rupture

- Loss of papillary muscle integrity
 - Typically occurs 3-7 days after infarct
- Hemodynamically, the most serious MV complication
- Most commonly involves small infarct of RCA or Circumflex (inferior, inferolateral MI) → posteromedial papillary muscle
- Rupture of RV papillary muscle rare



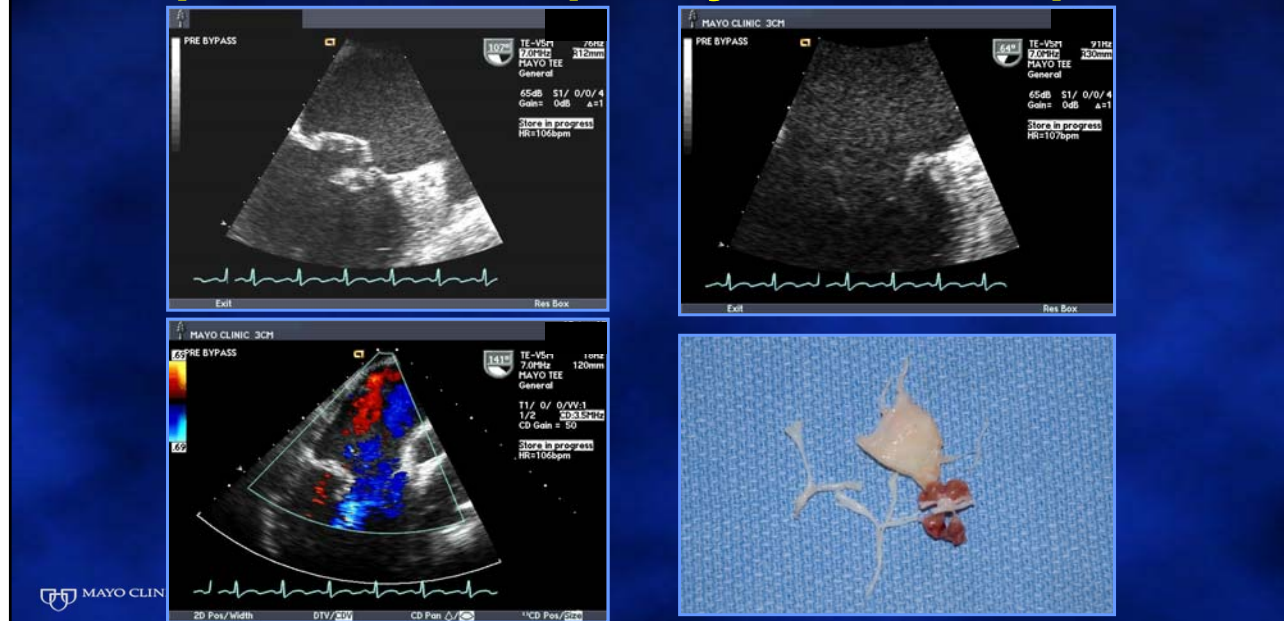
Ruptured Papillary Muscle



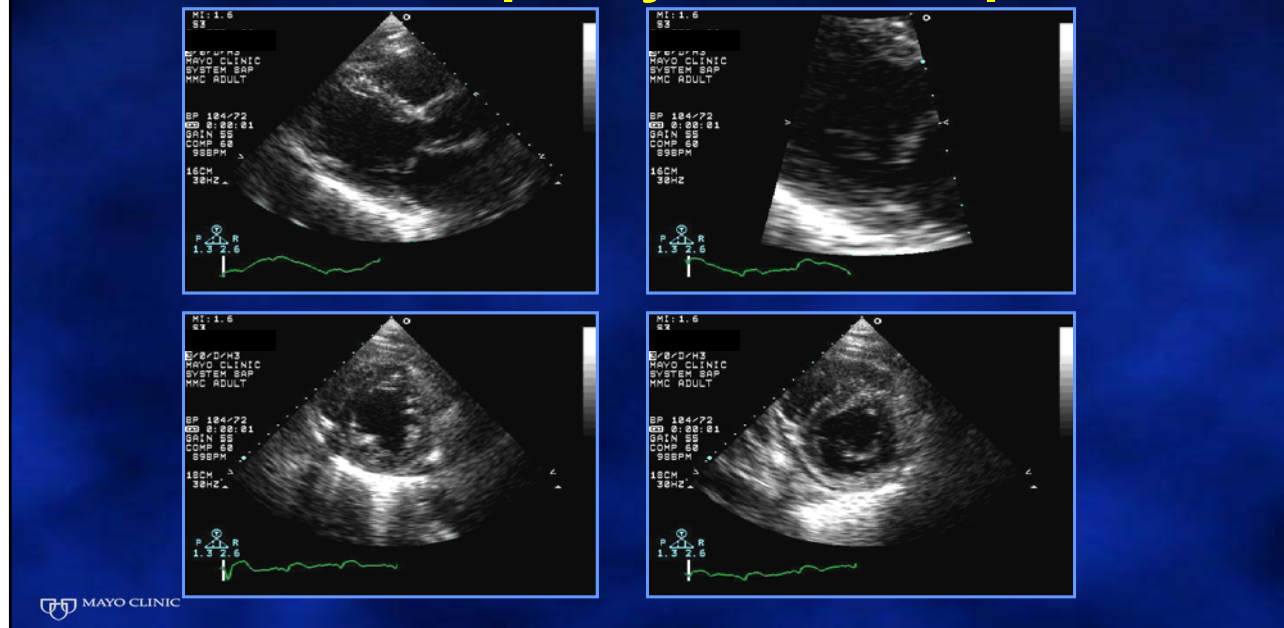
Video by Dr. Roger Click



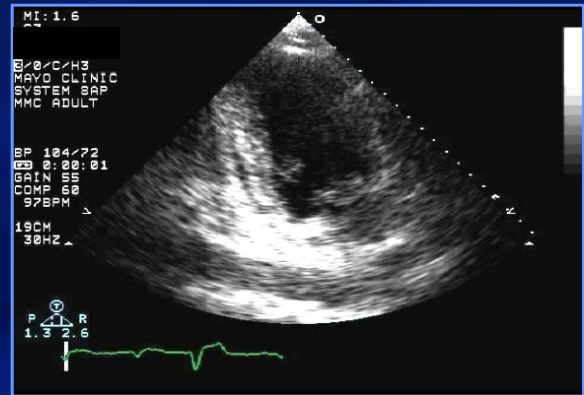
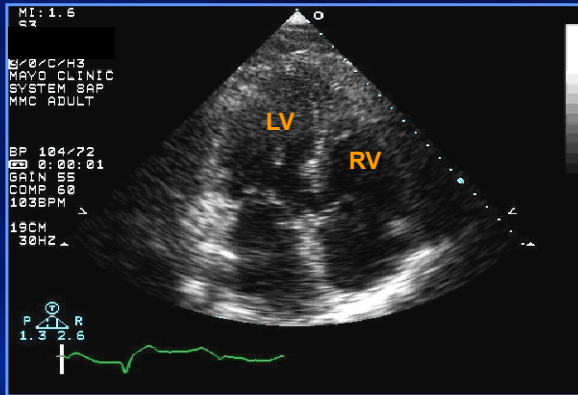
Spectrum of Papillary Muscle Rupture



Partial Papillary Muscle Rupture

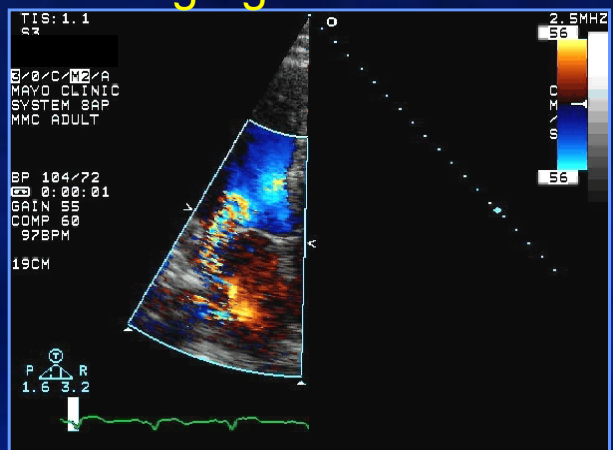
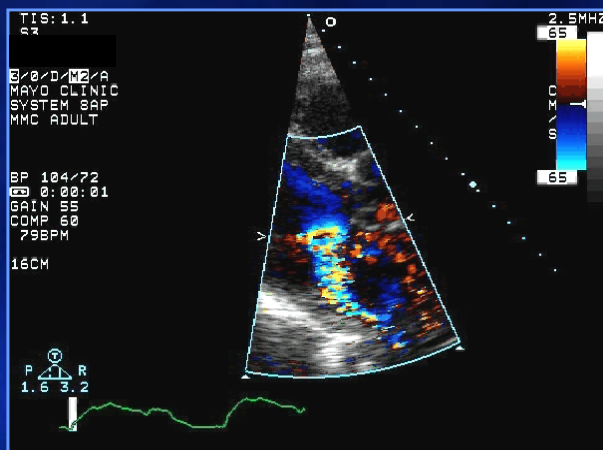


Partial Papillary Muscle Rupture: Chaotic Motion of Subvalvular Apparatus



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Partial Papillary Muscle Rupture Severe Eccentric Mitral Regurgitation



Patient underwent successful mitral valve repair

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Cardiovascular Surgery

Clinical Outcome After Surgical Correction of Mitral Regurgitation Due to Papillary Muscle Rupture

Antonio Russo, MD; Rakesh M. Suri, MD; Francesco Grigioni, MD; Véronique L. Roger, MD, MPH; Jae K. Oh, MD; Douglas W. Mahoney, MS; Hartzell V. Schaff, MD; Maurice Enriquez-Sarano, MD

Background—Papillary muscle rupture (PMR) is an infrequent but catastrophic complication of acute myocardial infarction (MI). Although always considered, surgical treatment is often denied because of high operative mortality. Moreover, the effects of surgery for PMR on long-term outcome, particularly compared with expected outcome after MI, are undefined.

Methods and Results—Fifty-four consecutive patients (age, 70 ± 8 years; 74% male) underwent mitral surgery for post-MI PMR from January 1980 through December 2000. Severe presentation (cardiogenic shock, pulmonary edema, or cardiac arrest) was noted in 91% preoperatively. Performance of coronary artery bypass graft was associated with lower operative mortality (odds ratio, 0.18; 95% CI, 0.04 to 0.83; $P=0.011$), whereas there was a trend for lower mortality after surgery after 1990 (odds ratio, 0.28; 95% CI, 0.06 to 1.3). Thus, operative mortality (overall, 18.5%) decreased from 67% up to 1990 without coronary artery bypass graft to 8.7% after 1990 with coronary artery bypass graft. Overall 5-year survival was $65 \pm 7\%$, and survival free of congestive heart failure was $52 \pm 7\%$. Five-year survival of 30-day operative survivors was $79 \pm 4\%$, identical ($P=0.24$) to that of matched controls with MI (similar age, sex, ejection fraction, MI location, and MI year). Survival free of congestive heart failure was similar in PMR cases and MI controls (10-year survival, $28 \pm 8\%$ versus $36 \pm 6\%$; $P=0.46$).

Conclusions—Surgery for post-MI PMR involves a notable operative mortality, but there are recent trends for lower operative risk, particularly with associated coronary artery bypass graft. Long term after surgery, outcome is restored to that of similar MI without PMR. These encouraging observations emphasize the importance of prompt diagnosis and aggressive therapeutic approach for patients incurring PMR after MI. (*Circulation*. 2008;118:1528-1534.)

Years



Adapted from Russo et al.

Differential Diagnosis of a New Loud Systolic Murmur Following MI

VSD

Pap Musc Rupt.

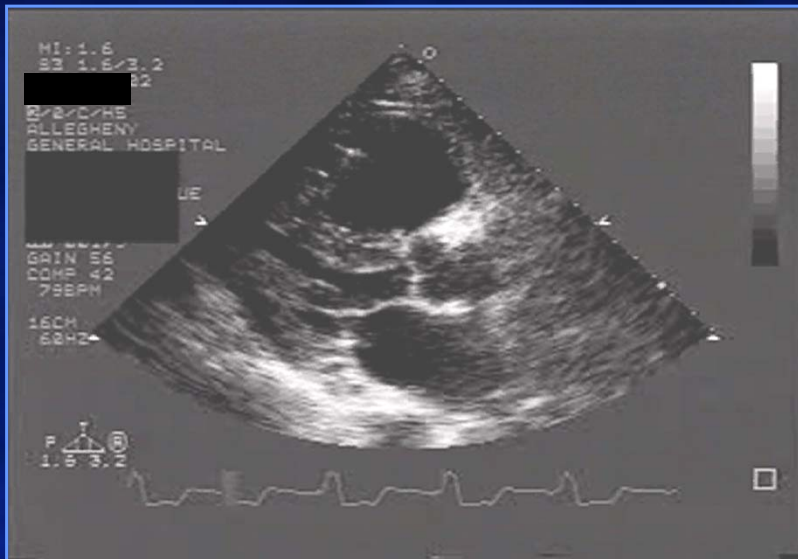
LVOT Obst.

| Location | Anterior or Inferior | Inferior > Anterior | Usually Anterior (Apical) |
|--------------|--------------------------------------|------------------------|------------------------------|
| Signs | Low Cardiac Output | Pulmonary Edema | Hypotension |
| Hemodynamics | O ₂ step-up (RA→PA) > 10% | V wave on PCWP tracing | Dynamic LVOT Obstruction |
| Treatment | Operation | Operation | Fluids, β-blocker, α-agonist |



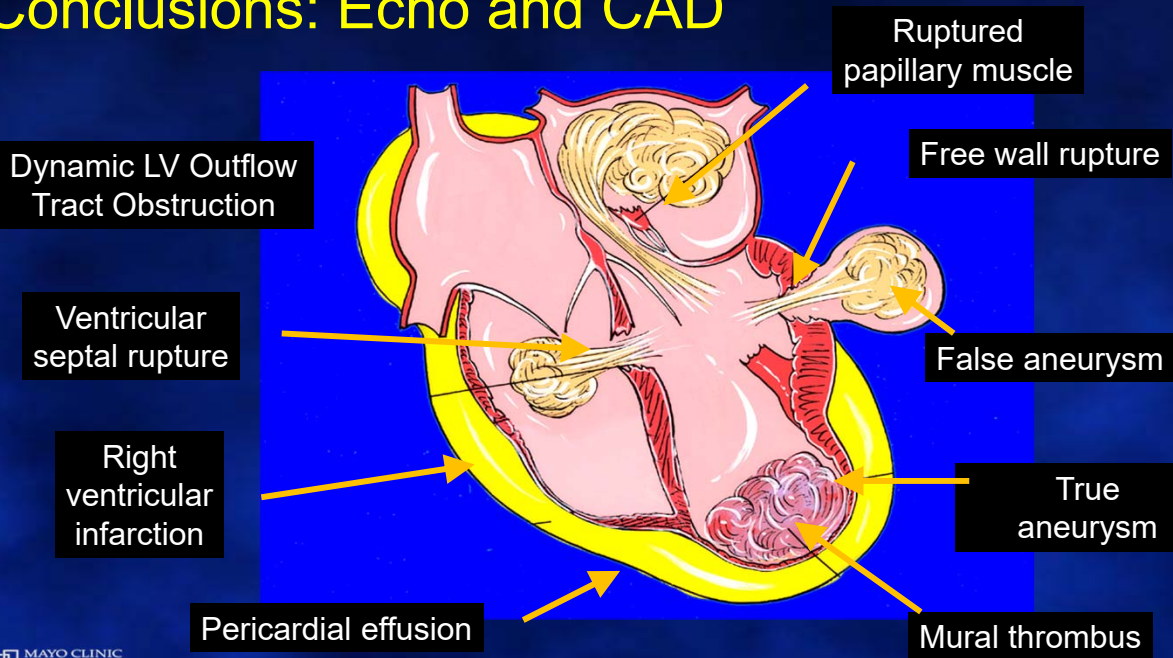
Adapted from Oh JK et al. Echo Manual 3rd Edition

Inferior MI with RV Infarction



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Conclusions: Echo and CAD



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Thank You!

mankad.sunil@mayo.edu
@MDMankad

